

**No. 26**

**How To Align Simple  
One-Band Receivers**

**RADIO-SERVICING METHODS**



# NRI TRAINING

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Dear Mr. Smith:

I commenced to repair radios three months after starting the Course. By the time I graduated I had made a net profit of \$567 from spare time work. I am still in spare time work, making something every week and at times turning down jobs because I get too many to handle. You will never know how glad I am that I took your Course, for if anything should happen to my job I won't have to worry; I have something to fall back on.

J.C., New York



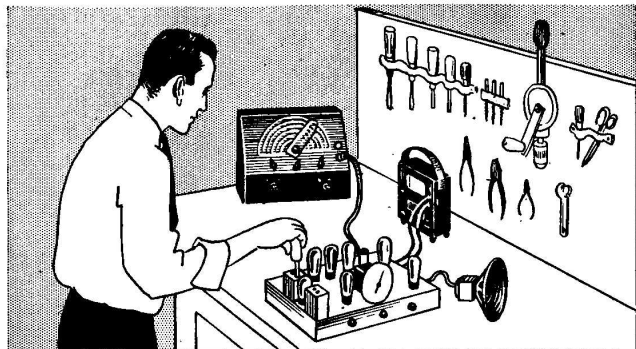
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**NATIONAL RADIO INSTITUTE  
WASHINGTON, D. C.**

FM10M548

1948 Edition

Printed in U.S.A.



## How To Align Simple One-Band Receivers

**A**LIGNMENT is the name applied to the process of adjusting the tuned circuits of a receiver to give the set maximum sensitivity and selectivity and make stations come in at the right points on the dial. This is a part of most service jobs. There are many service complaints, particularly those involving weak reception (low sensitivity), that are caused chiefly by poor alignment. In addition, in the great majority of radio jobs in which an overhauling is involved, the set must be re-aligned to restore it to maximum performance.

Provisions for alignment are found on practically all radio receivers. Set manufacturers know that the natural aging of coils and condensers in the tuned circuits, or changes in the electrical values of these parts caused by vibration and temperature variations, throw even a perfectly aligned set out of adjustment after a period of time. And, of course, the manufacturer provides adjusters for his own convenience in aligning the set in the first place.

As you know, a resonant circuit can be tuned to a desired frequency by varying either its capacity or its inductance. In modern radios, the variable tuned circuits are ganged—that is, they are tuned simultaneously by moving a single shaft (the tuning shaft). In capacity-tuned sets, this shaft operates an air condenser

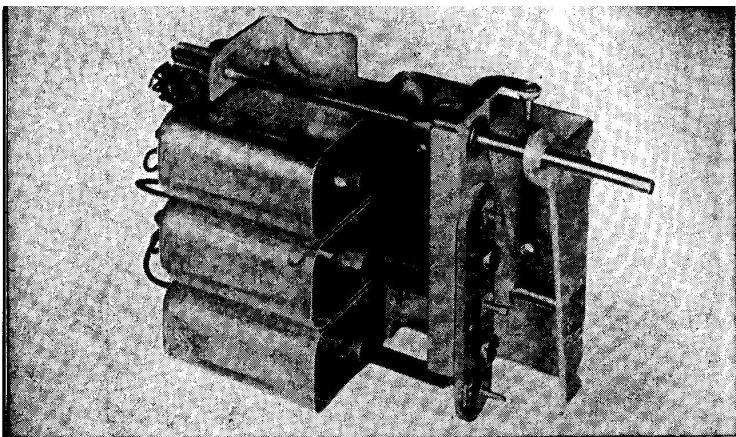


FIG. 1. Each coil in this permeability tuning unit can be aligned by turning the small screw that secures the core to the tuning mechanism. This changes the position of the core with respect to the tuning bar and so changes the inductance of the coil with respect to the others.

having two or more sections; in inductance-tuned sets, the shaft varies the position of powdered iron cores in two or more coils (thus varying their inductance). Alignment adjustments are usually made in capacity-tuned sets by varying the capacities of trimmer condensers that are connected in parallel with the sections of the main tuning condenser. No extra trimmers are used in inductance-tuned sets; instead, alignment adjustments are made by turning screws or nuts that change the positions of the powdered iron cores in their coils. (In some capacity-tuned sets, also, low-frequency adjustments are made by varying the inductances of coils in the tuned circuits.) Fig. 1 shows an adjustable inductance.

The resonant circuits used in the i.f. stages of a superheterodyne are also adjusted by varying either their capacity or their inductance. Adjustment of these circuits is part of every alignment job.

The alignment of t.r.f. sets and simple one-band superheterodynes by setting these adjusters is a fairly simple matter. The complete procedure for these receivers will be covered in this Booklet; the alignment of multi-band, high fidelity, and FM sets will be taken up later. First, we'll see what symptoms indicate that a set needs to be aligned.

## WHEN IS ALIGNMENT NEEDED?

You can generally be sure a set needs alignment if it has both poor selectivity and poor sensitivity. If the sensitivity is poor, but the selectivity is good, or vice versa, the alignment is not to blame; some part or circuit is defective, or else the receiver design may be at fault.

Alignment is also needed if the set does not track properly with the tuning dial—that is, stations do not come in at the proper point on the dial. With superheterodynes, improper tracking or low sensitivity may be spotty: stations may be received well at one end or in the middle of the dial, but not at the other end.

These symptoms may not be extremely noticeable if the poor alignment is caused by natural aging of the receiver, but they may be very pronounced if someone has tampered with the adjusters. In fact, it is easily possible for a receiver to be altogether dead if the adjusters are turned far enough from their correct positions.

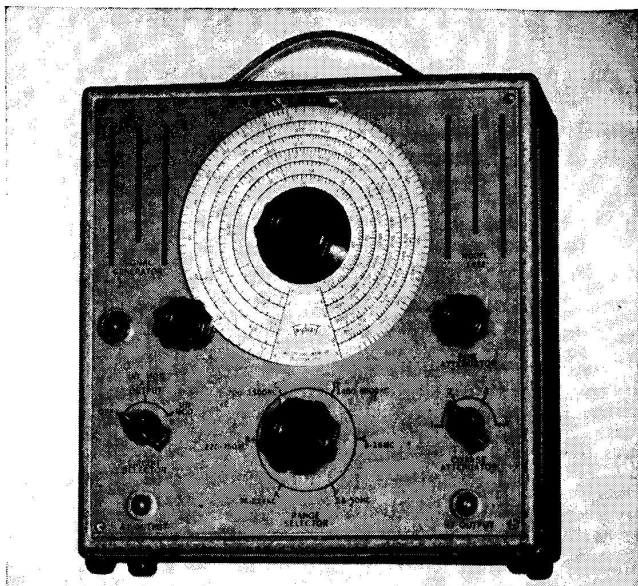
Now let's see what equipment you will need to align a set.

## EQUIPMENT NEEDED

For all ordinary alignment jobs, only three pieces of equipment are required—a signal generator, an output indicator, and alignment tools.

**Signal Generator.** Although it is possible for an expert to align a simple receiver satisfactorily using broadcast signals, you should use a signal generator (s.g.) while you are gaining experience. Even when you are expert, you will use an s.g. when you want to get maximum performance out of a set. The s.g. must be accurately calibrated and capable of being tuned from 550 to 1600 kc. (the broadcast band r.f. range) and from 170 to 480 kc. (a range that includes all the commonly used i.f.'s). The s.g. should have a control for varying its output voltage, and there should be a way to modulate its output with a tone signal when desired.

A typical signal generator is shown in Fig. 2. This



Courtesy Triplett Electrical Instrument Co.

FIG. 2. An a.c.-operated signal generator of this general type is the kind most servicemen choose. When a.c. is not available, then battery-operated types are used.

instrument has a dial knob, by which the frequency of the instrument can be varied. The circuit-selector knob lets you select the kind of output you want (modulated or unmodulated). The range-selector knob is used to select the proper range of frequency from the six available. The strength of the signal is controlled by turning the attenuator knobs. The signal is fed out of the instrument through a shielded cable; the shield has a ground clip, and is used as the ground lead. It is always clipped to the chassis or ground of the receiver being aligned. The lead inside the shield ends in a probe through which the output signal of the s.g. is fed into the set. This is generally called the "hot" lead of the s.g.

**Output Indicator.** The output indicator may be the tuning eye of the radio, or it may be part of a multi-meter. We will discuss this in more detail a little later on.

**Aligning Tools.** Any ordinary screwdriver or hex nut driver could be used for alignment except that there

is liable to be considerable capacity between your body and the circuits of the set. If a metallic screwdriver or wrench is used, your body capacity may affect the alignment. To minimize this capacity effect, alignment tools are made of fiber, bakelite, or other insulating material. This insulation is also desirable to prevent shorts, since there may be considerable voltage difference between the adjustment screw or nut, and the chassis.

The usual set of alignment tools includes a rod having a screwdriver bit on one end, and a hex wrench on the other, together with a larger hex wrench. A typical set is shown in Fig. 3. The smaller wrench will take care of practically all jobs, but there are a few for which the larger wrench may be needed.

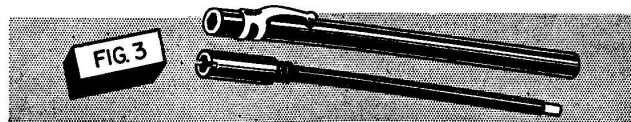
A few manufacturers specify special alignment tools for their sets. It is usually possible to align them with ordinary tools, but you may find it will speed up your work to use the special tools recommended.

**Manufacturer's Instructions.** You should have the manufacturer's alignment instructions whenever possible. They will speed up the job by telling you exactly what to do for that particular set and by showing you the positions of the trimmers.

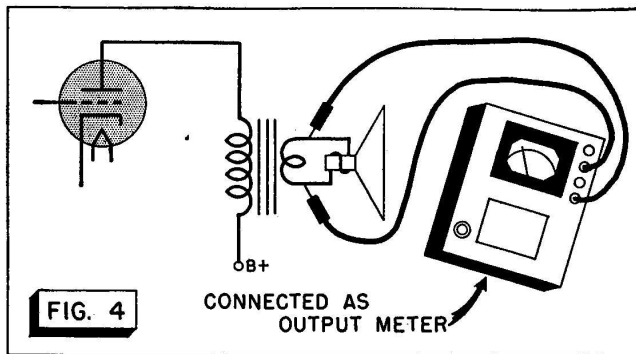
## OUTPUT INDICATOR CONNECTIONS

We won't discuss signal generator connections until later, since they differ in different types of sets. However, the same output indicator connections can be used for any kind of set, whether it is large or small, t.r.f. or superheterodyne.

An output indicator is used to indicate when the adjustment being performed has reached the point of maximum output. If the set uses a tuning indicator, such as a meter or magic eye, it is not necessary to use anything else as an output indicator. Proper alignment will be indicated when maximum closure of the eye occurs, or when maximum meter swing is obtained.

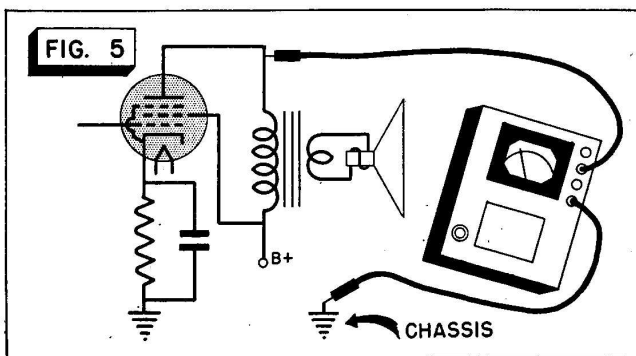




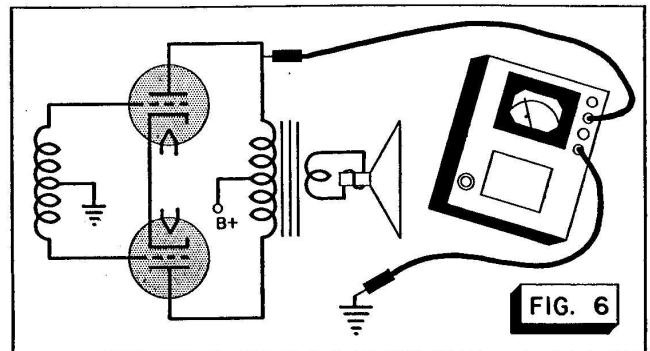


If there is no magic eye or tuning indicator on the set, then you can use the a.c. voltmeter of your multimeter in the audio system, or you can use the d.c. voltmeter across the diode load.

► One of the most common connections for the output meter is that shown in Fig. 4. (The OUTPUT jack of the multimeter is used, because there is a blocking condenser in series with it. Although there is no d.c. voltage to block out when the connection shown in Fig. 4 is used, it is advisable to be in the habit of using the blocking condenser always so that you will never forget it when it is needed.) Effectively, this connection puts your a.c. voltmeter across the voice coil. The a.c. voltage here is low, and it is possible that the multimeter will not have an a.c. voltage range sufficiently low to give readings. If so, you can use one of the connections shown



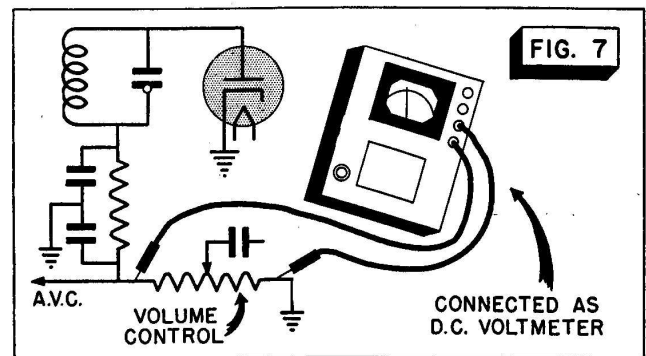
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in Figs. 5 and 6, which connect your meter across the plate circuit of the output tube. Here, the audio voltage is much higher—on the order of 15 to 75 volts. Any standard multimeter can measure voltages this large.

In all three of the above connections, the a.c. voltmeter measures the audio output voltage. When you use a signal generator, this will be the output voltage produced by the modulating tone of the signal generator.

► Another popular connection is that shown in Fig. 7. Here, a d.c. voltmeter is connected across the diode load, and is used to measure the a.v.c. voltage. This voltage varies directly with the strength of the carrier of the signal. The d.c. voltmeter used must have a sensitivity of 5000 ohms-per-volt or more, so that it can be connected directly across the diode load without upsetting the circuit too much.



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There is an advantage to the connection in Fig. 7—the volume control can be turned down to where the output from the loudspeaker is at a comfortable level, without affecting the reading on the d.c. voltmeter. In the other methods, the loudspeaker output may have to be rather high to give a reasonable indication on the a.c. voltmeter.

As we said earlier, your effort in aligning a set is to find the circuit adjustments that will produce a maximum voltage indication on the output indicator. Except in high-fidelity band-pass receivers, this is true no matter which of these methods you use for connecting the output indicator.

Now that you have a general idea of what equipment is used, let's see exactly how to align various kinds of one-band receivers. We'll start with the t.r.f. set.

### T.R.F. ALIGNMENT

In recent years, the only t.r.f. receivers manufactured have been some of the very inexpensive a.c.-d.c. midget receivers. A typical example is shown in Fig. 8. These sets are quite simple and have but a single r.f. stage, which feeds into a detector circuit.

Many of the older t.r.f. receivers are still in existence, however, and these, too, need alignment. The following instructions will show you how to align any kind of t.r.f. set that uses screen grid or pentode tubes in the r.f. stages. However, an old receiver that uses triode tubes may be a neutrodyne, which requires an additional adjustment; this will be described later in this Booklet. ► Almost every t.r.f. radio you will meet will have a set of trimmer condensers, one in parallel with each section of the main tuning condenser, so that each tuned circuit can be adjusted to give maximum output at the same signal frequency. The adjustment is always made near the high-frequency end of the band, because small circuit changes have the greatest effect at this end. If no over-all equalizing adjustment is provided, the rest of the tuning band may not be in adjustment for maximum response, but will usually be satisfactory.

Since few t.r.f. receivers have diode detectors or a.v.c. circuits, you will probably connect your output meter

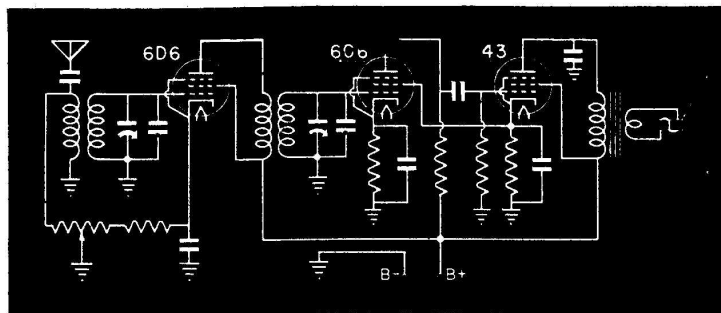


FIG. 8. A typical midget t.r.f. set of simple design.

between the plate of the output tube and ground. Next, disconnect the antenna wire, and connect the hot (ungrounded) lead of your s.g. cable to the antenna terminal or wire of the receiver. Connect the ground lead of your s.g. to the ground post of the receiver (or to the chassis if there is no ground post).

To make the alignment, tune your s.g. to some frequency around 1400 kc. at which no station is heard. Tune the set dial to exactly the same frequency. Turn on both the s.g. and the set, and allow them to warm up for a few minutes so that they will become stable in operation. Then adjust each trimmer, in turn, until the output indicator gives maximum reading. (You will usually find these trimmers mounted right on the tuning condenser gang.) The set is aligned when you cannot adjust any trimmer further without causing a drop in the output indication.

**Receivers Without Trimmers.** A few of the very early t.r.f. receivers did not have trimmer condensers. Although in some of these sets it is possible to make a rough alignment by varying the position of the gang tuning condenser rotor plates on their shaft, or by moving the leads of the tuned circuits closer to or farther from the chassis (thus changing the stray capacities in the circuits), we don't advise you to fool with it. The customer needs a more modern receiver.

**Receivers Having Trimmers and Split Rotors.** A few of the better early t.r.f. receivers were designed to be selective and sensitive over the entire broadcast band.

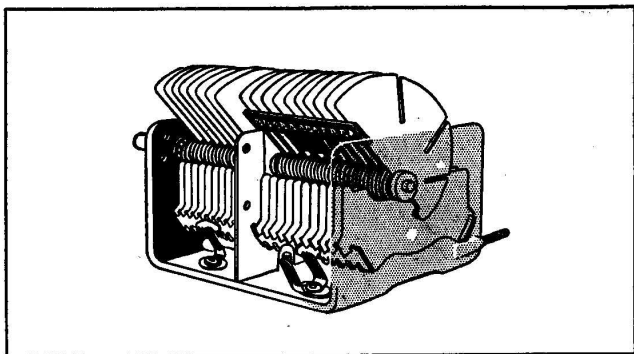


FIG. 9. This illustrates the split rotor used in the tuning condensers of both old and modern sets. For clarity, the end bracket of the condenser has been shown in phantom.

To make this possible, not only do these sets have trimmers that are used to make the initial adjustments, but also the last plate on each rotor section is split or segmented, so you can bend a section of the rotor plate in or out at various points over the tuning range (see Fig. 9). This makes it possible to align the circuit at several frequencies over the band.

To align this kind of receiver, first adjust the trimmers for maximum output with the s.g. tuned to 1400 kc. Then, rotate the tuning condenser gang until only the first split rotor segment meshes completely with the stator section. Retune the signal generator to give maximum output at this receiver dial indication. Now bend the first segment (the meshed segment) on the rotor of each condenser section in or out until the output indicator shows maximum voltage. Turn the tuning knob again until the second rotor segments are completely meshed, retune the signal generator for this new setting, and repeat the adjustment for the second segments on each of the condenser sections. When all the split segments have been adjusted in this manner for maximum output, retune the receiver to 1400 kc., and readjust the trimmers to compensate for any effect caused by bending the rotor plates.

**Alignment Pointers.** If there is any question in your mind about the alignment procedure at any time, be

sure to consult the manufacturer's information on that receiver. If you don't have such instructions, the NRI Consultation Service will be glad to help you.

► When you are to align a t.r.f. receiver, be sure that first you give it a thorough overhauling, clean out all dust and grime from the r.f. coils and the tuning condenser, and blow out all dust and dirt from the chassis. Don't align any receiver until all shields and shield connections are in place, and don't adjust any trimmer condenser until you know its purpose. An important rule to remember is that the trimmers you are to adjust will always be connected in parallel with the main tuning condensers and will usually be on the gang itself. *Don't touch any trimmer not connected in parallel with the gang tuning condenser*; it is in the circuit for some purpose other than alignment.

## HOW TO NEUTRALIZE

At one time the neutrodyne receiver was extremely popular, so you may still occasionally get one to service. It was one of the first t.r.f. receivers to have high sensitivity without being prone to squeal or oscillate. However, this characteristic is produced by feeding back energy out of phase with that which would otherwise cause oscillation. Therefore, whenever such a receiver gets out of balance, or if there is any change in its tubes, it will oscillate.

You can be sure a set is a neutrodyne if it uses triode tubes as r.f. amplifiers (the screen-grid tube made the neutrodyne circuit unnecessary) and has trimmers on the chassis that are not in parallel with the tuning condenser gang. On some receivers you may have to look carefully for hidden neutralizing trimmers. An example is a series of early RCA receivers in which the neutralizing trimmers were actually underneath the tuning condenser gang. It was necessary to take the entire gang off the receiver to reach the neutralizing adjusters.

**Neutralizing Procedure.** The alignment procedure for a neutrodyne is the same as the one you just learned for other t.r.f. sets. However, if the receiver is oscillating or squealing, you must neutralize it before you can align it. If the set is not oscillating, you can go ahead

with the alignment procedure until you throw the set into oscillation, at which point you will have to neutralize. The general neutralizing procedure is as follows:

1. Open the filament or heater circuit of the tube in the last r.f. stage by unsoldering a supply lead from a filament terminal on the socket.

2. Turn the receiver on. Be sure the disconnected tube does not light, then tune the receiver to a local broadcast station operating on a frequency somewhere near 1500 kc., or connect your signal generator to the antenna and ground terminals of the receiver and tune both to the same frequency near 1500 kc.

3. With no filament emission, this one tube will have no plate current. However, if the stage is out of neutralization at all, the signal to which the receiver is tuned can be heard from the loudspeaker. This means that the signal is passing from the grid to the plate (via inter-electrode capacity) inside the cold tube. This stage therefore needs neutralizing in order to cancel the undesirable feedback signal.

4. Adjust the neutralizing condenser in the stage until the signal is at *minimum* volume or cannot be heard, then retune the receiver for maximum volume, and readjust the neutralizing condenser for minimum volume. This completes the neutralizing adjustment for one stage. (IMPORTANT: Once a stage has been neutralized, do not make any changes in that stage, and, above all, do not change the tube in that stage, otherwise you will have to re-neutralize.)

5. Turn off the set, and restore operation to the tube by reconnecting the filament lead.

6. Repeat this procedure with all other r.f. stages, one by one, working toward the antenna.

When you have neutralized all the stages, the set should not oscillate at any point over the band. However, if you find it squeals at some other frequency, say at 800 kc., after you have eliminated the squealing at 1500 kc., you may find it necessary to reduce regeneration in some other way, possibly by reducing the plate voltage. One way to do this, on receivers having line voltage switches or taps, is to move the switch or tap to a setting corresponding to a higher line voltage. This



You should strive to keep your own shop as neat as this one. It pays, as the success of this NRI graduate proves.

will reduce plate voltages enough to stop oscillation.

Sometimes a tube cannot be neutralized properly. If you find a stage that does not respond to neutralization, and can trace oscillation to this stage, try another tube in that stage, and check the stage wiring carefully. Of course, before you can neutralize, all shields must be in place. If there is any missing shielding, it must be found or replaced by equivalent shielding.

### SUPERHETERODYNE ALIGNMENT

You will, of course, have more superheterodynes than any other type of receiver to align. In the superheterodyne, as you will recall, a local oscillator signal is mixed with an incoming signal to produce an intermediate-frequency signal. This intermediate-frequency or i.f. signal is then amplified by the i.f. amplifier. For a superheterodyne to work properly, the preselector stage must tune to the frequency shown by the setting of the tuning dial. At the same time, the local oscillator must tune to another frequency that is exactly equal to that of the incoming signal plus the i.f. frequency. Finally, the i.f. amplifier must be resonant to the i.f. frequency. Therefore, the preselector, the oscillator, and the i.f. amplifier must be in alignment before the set will work properly.

The general procedure for aligning a superhetero-



dyne receiver is first to align the i.f. amplifier by feeding in an i.f. signal and adjusting the i.f. trimmers or coil cores to give maximum output at this frequency. Then the oscillator and preselector sections are adjusted to give maximum output and to track the dial properly.

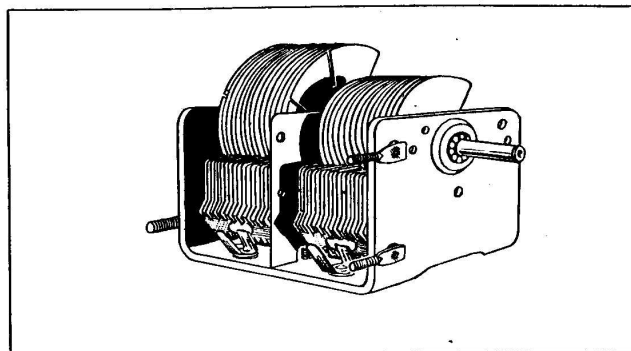
As you have learned from your Course, producing proper tracking is somewhat of a problem in a superheterodyne. The reason is that the resonant frequency of the oscillator must stay a fixed number of kilocycles above that of the preselector at all points on the dial. Therefore, as the tuning knob is rotated, the tuning capacity of the oscillator stage must change in one fashion, and the tuning capacity of the preselector stage must change in a somewhat different manner. (We are now speaking of capacity-tuned sets; the same is true for those using permeability tuning if you substitute "inductance" where we say "capacity.") If you don't recall the reason for this, review your Lesson on superheterodynes.

These different changes in capacity in the two stages can be produced in either of two ways. In some sets, the plates in the oscillator section of the gang tuning condenser are shaped differently from those in the preselector section. In others, both sections of the condenser gang have plates of the same shape, and the oscillator stage contains either a series-connected padder condenser (a fairly high-capacity adjustable condenser) or uses a variable-permeability coil that can be adjusted to make the stage track with the preselector at low frequencies. Usually, no low-frequency adjustment is made on a set that has differently shaped plates for the oscillator and preselector sections of the gang condenser.

#### STANDARD ALIGNMENT PROCEDURE FOR SUPERHETERODYNES

For our first example, we shall assume that the receiver has not been tampered with—that it plays, but has lower-than-normal sensitivity and selectivity.

The first step in aligning a superheterodyne is to make sure the dial pointer is properly adjusted. This is necessary because you will have to read the dial setting accurately during the alignment procedures; you can't,



This picture shows the difference between the oscillator and preselector sections of one type of tuning condenser. The oscillator, which operates at the higher frequency, is tuned by the smaller section.

of course, if the pointer has slipped from its proper position. There is usually a "calibration mark" at one or the other end of the scale; the pointer is adjusted to indicate this position when tuned to this end of the range. If you don't have the manufacturer's instructions, and can't determine this mark, then adjust for equal coverage of the dial range when the tuning knob is turned in either direction, if an adjustment is required.

Next, connect an output meter to the set in any of the ways described earlier in this Booklet.

**I.F. Alignment.** For i.f. alignment, you have a choice of two possible connecting points for the signal generator. If the first detector tube has a top cap, connect the s.g. between the top cap of this tube and the set chassis; if it does not, connect the s.g. to the antenna and ground terminals of the receiver.

Many midget superheterodynes have loop antennas. If no antenna and ground posts (or leads) are provided on such a set, you can feed a signal into the loop by making a two- or three-turn loop of hook-up wire, connecting this loop to the hot s.g. lead, and bringing it close to the receiver loop. The s.g. ground lead may be connected to the set chassis.

When the proper connections have been made, turn

on the receiver and the s.g. and allow them to warm up for about 15 minutes. When the warm-up period is over, tune the receiver to a quiet point near the low-frequency end of the band (around 550 kc.) so that the preselector will not interfere too much with the s.g. signal. Then, tune the s.g. to the i.f. frequency of the receiver.

The manufacturer's instructions and the set diagram will usually give the i.f. frequency. For that matter, since the receiver plays reasonably well, you can find the i.f. frequency just by determining what frequency from the s.g. comes through loudest. If it is near one of the standard i.f. frequencies, you can use that standard frequency for the alignment. Practically all modern receivers use an i.f. frequency of 175, 262, 456, 465, or 480 kc. Thus, if the signal seems loudest at about 455 kc., use 456 kc. as your s.g. setting, and align the i.f. amplifier to that frequency.

With an ordinary single-band receiver that is not of the high fidelity or band-pass type, it makes no difference which i.f. trimmers you adjust first. Merely adjust all of them for a maximum reading on the output meter.

You will usually find these i.f. trimmers on top, on the side, or at the bottom of the i.f. transformer shield cans, although there are a few early receivers in which the i.f. trimmers are separated from the i.f. transformers. (With these latter you may have to depend on the manufacturer's instructions or trace the circuit to determine which trimmers adjust the i.f. amplifier and which are used for other purposes.)

In some sets, the output i.f. transformer (the one feeding the second detector) may have only one trimmer. However, there are a few sets in which one trimmer is on the top of the can and the other on the bottom, so be sure to look carefully for two trimmers before deciding there is only one.

► After you have adjusted the i.f. amplifier, connect the s.g. to the antenna-ground terminals or arrange to feed a signal into the receiver loop (if it is not already so connected). Next, adjust the preselector and the oscillator at the high-frequency end of the band, then adjust the oscillator at the low-frequency end of the band (if the set has provisions for this adjustment).

**High-Frequency Adjustments.** With the signal generator connected to the input of the receiver, tune the receiver to its highest frequency dial reading. Set the signal generator to the same frequency. Then adjust the oscillator trimmer (usually on the oscillator section of the tuning condenser gang) for maximum output.

► Next, tune the receiver and signal generator to a frequency of about 1400 kc., and adjust the preselector trimmer (or trimmers) for maximum output. This trimmer is generally on the preselector section of the gang.

Some receiver instructions will tell you to adjust the oscillator and preselector together at 1400 kc. If you do so the receiver dial may not track exactly at frequencies around 1600 kc. Of course, since there are only police stations near this frequency, that won't matter much.

**Low-Frequency Adjustments.** If the oscillator uses specially cut oscillator plates, there will probably be no low-frequency adjustment, so you will be through with the alignment after carrying out the above procedure. However, if there is a padder, or if the oscillator coil core is adjustable, you should make an adjustment at about 600 kc.

You can make a low-frequency adjustment by tuning the set and the s.g. to 600 kc. (or some nearby frequency where no station is received) and adjusting the low-frequency padder or the coil core for maximum output. However, when the maximum in sensitivity is wanted, it is better to use the procedure known as "rocking."

► To make a rocking adjustment, tune the s.g. to about 600 kc. and leave it set at this frequency. Now tune the receiver to get maximum output, *regardless of the dial setting*. Note the exact output meter reading. Then, change the setting of the oscillator padder condenser (or of the coil core) slightly, and retune the receiver for maximum output. Notice whether the reading on the output meter has increased or decreased. If the reading increased, keep on changing the oscillator adjustment *in the same direction*, tuning the set each time, until you find the point at which you get the *maximum* output meter indication. If the second reading is less than the

first, change the oscillator adjustment in the opposite direction, and retune the set, keeping up the procedure until the highest output reading is obtained.

This rocking procedure increases the receiver sensitivity (at the sacrifice of dial tracking somewhat) by effectively tuning the local oscillator and preselector simultaneously. (Changing the receiver dial setting tunes the preselector, while the oscillator is tuned by the combination of the padder adjustment and the dial change.)

► If you make any change in the padder or oscillator coil setting, you must go back to the high-frequency setting at about 1400 kc. and readjust the oscillator trimmer to get the dial to track properly, and to get the maximum output at this frequency. Sometimes you will then have to make the low-frequency and high-frequency adjustments again. Always wind up with the high-frequency adjustment. After one or two repetitions of these adjustments, the receiver dial should track reasonably well, and the set should have maximum selectivity and sensitivity.

Notice that this alignment procedure is not a matter of making one definite adjustment, but is rather a back-and-forth process. One adjustment affects the other, so you have to make slight changes in both to get the best possible setting of the trimmers.

#### HOW TO ALIGN A SUPERHETERODYNE AFTER THE ADJUSTMENTS HAVE BEEN TAMPERED WITH

If someone has tampered with the adjustments, you will have to consult the manufacturer's instructions to determine the correct intermediate frequency. Then, it is possible that you can't get the i.f. signal to go through the set at all when the s.g. is connected to the antenna or to the first detector terminals. In this case, you must connect the s.g. to the grid of the i.f. tube (the one nearest the second detector, if there is more than one), thus forcing a signal through the last i.f. transformer alone. (Usually some signal will travel through just one transformer no matter how badly mis-aligned it is.) Once you have brought this transformer to alignment, move

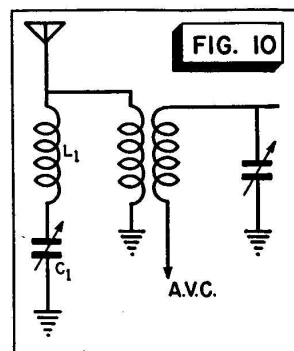
the s.g. back to the next i.f. stage if there is more than one, and align the middle i.f. transformer. Finally, connect the s.g. to the first detector or to the antenna-ground post and align the remaining i.f. transformer. You can now make a final adjustment of all the i.f. trimmers to bring the transformers into precise alignment.

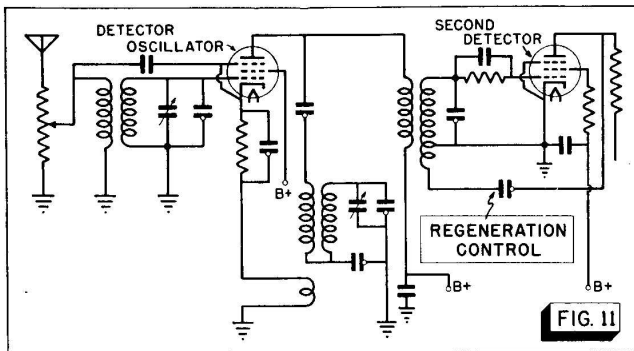
► Once the i.f. amplifier is aligned, you can usually get the set back into alignment by tuning the receiver dial to, say, 1400 kc. and then varying the s.g. dial until a signal comes through. When you get the signal through, adjust the oscillator trimmer condenser for maximum output. Next tune the s.g. toward the correct frequency (toward 1400 kc., in this case) until you can just barely hear the signal, and readjust the oscillator trimmer for maximum output. Continue this process of tuning the s.g. toward the proper frequency, then readjusting the oscillator trimmer, until the s.g. is at the same setting as the receiver dial. If you can do so before the oscillator trimmer condenser is screwed all the way in or out, your high-frequency alignment has been made; you can then make the padder adjustments we described earlier.

Sometimes, however, you will find that the oscillator trimmer does not have enough range to let you make the high-frequency adjustment this way. If so, go to the low-frequency end of the dial and make a rocking padder adjustment, then try the high-frequency adjustment again. You may have to make both adjustments several times, but eventually you will get the set aligned.

#### MISCELLANEOUS ADJUSTMENTS

In a few sets you will find an extra trimmer on the chassis, that is connected as is  $C_1$  in Fig. 10. This trimmer and the coil  $L_1$  form a wave trap that is used to prevent an interfering signal from entering the input of the receiver. Generally these wave traps are designed to





work at the intermediate frequency of the receiver, since code stations operating at this frequency can cause a great deal of interference.

If such interference actually exists when you are aligning the receiver, simply adjust  $C_1$  for minimum interference. If you do not hear any interference at the moment, but want to guard against it anyway, connect your s.g. to the aerial and ground posts of the receiver and tune it to the intermediate frequency, then adjust  $C_1$  until a *minimum* signal is heard in the loudspeaker.

**Regenerative Superhet.** Fig. 11 shows the superheterodyne part of a widely used midget receiver circuit. Receivers using this circuit are unique in that they have no i.f. amplifier tube. The output of the first detector feeds into an i.f. transformer. The output of this transformer feeds directly into the second detector. Sensitivity is obtained by making the second detector regenerative.

The trimmer condenser marked "REGENERATION CONTROL" in Fig. 11 determines the amount of feedback from the plate to the grid circuit of the second detector. To align this set, proceed as you would with any other superheterodyne, aligning first the i.f. stage (which consists of the i.f. transformer only, in this case), then the preselector and oscillator. The set may go into oscillation as you align it; if so, tune in a signal near the high-frequency end of the dial, and turn the screw of the regeneration control trimmer counter-clockwise (thus reducing the feedback) until the os-

cillation ceases. When the alignment is finished, turn this screw clockwise until the set oscillates; then turn it counter-clockwise until the oscillation ceases and continue turning it counter-clockwise for one-half to one turn more. This procedure sets the amount of feedback at a value that is just short of enough to make the receiver oscillate, and so give it maximum sensitivity.

**Looking Ahead.** We have not included any Practical Experience section in this Booklet because we prefer that you read the next Booklet before practicing set alignment. This next Booklet will show you how to align all-wave superheterodynes. It will contain all sections of the Practical Experience Plan relating to alignment.

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